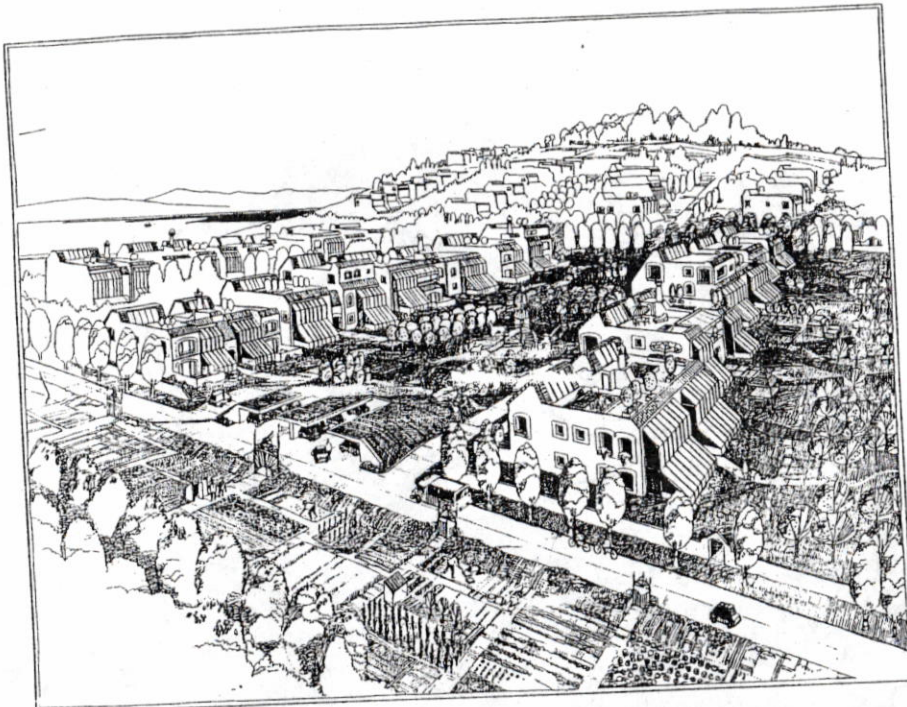




NEW SOLAR HOUSING

Project 3: Marin Solar Village

John Todd

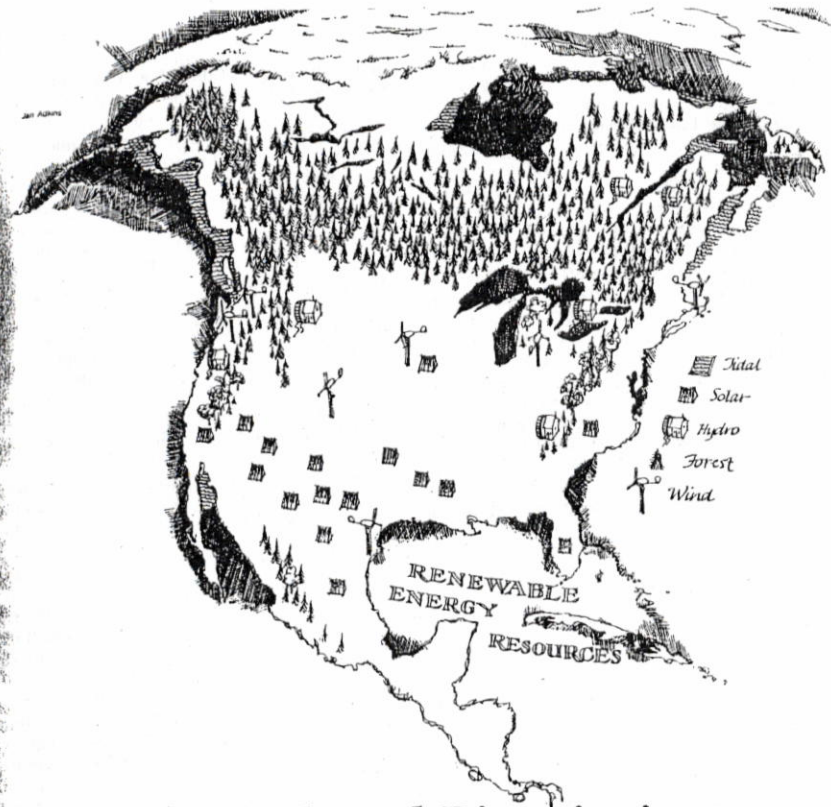
Marin Solar Village, adjacent to San Francisco, is the brainchild of Sim Van der Ryn and his associates. It is a bold attempt to create from an Air Force base a village of the sun with wide public acceptance.

As of this writing, many of the political hurdles have been overcome. Underway now are the intensive design and cost-projection phases. The following text and drawings provide an overview of what may become the first village of the sun. It is

also the beginning of a village as a solar ecology. It could well become an important milestone for us all.

The reuse of Hamilton Air Force Base is an opportunity to build the most modern community on the planet designed to sustain a high-quality life based on ecological balance and the efficient use of energy. It will provide 800 new solar dwellings, 1,500 new jobs in a corporate center and light industry, a transit center to ease freeway congestion, on-site food and energy production, and an open space for wildlife and recreation. Solar Village will be privately financed with no cost to the county, making Marin first in the nation with practical approaches to our problems of energy, economics, and environment.

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Scale and Diversity in Energy Systems

Joe Seale

It is possible for the energy needs of this country to be supplied by applied solar technologies, if energy sources are matched to specifics of location and end use. The form of solar-derived energy must vary from place to place. Half of the United States lacks decent windpower sites. Both the wind and biofuel potentials of most of Nevada, Utah, Arizona, and New Mexico are poor. The Southeast and southern California have few good windpower sites. Solar energy prospects are poor for the Pa-

cific Northwest, especially near the Pacific coast, as well as for the eastern Great Lakes region extending into Pennsylvania and New York. But few regions lack the capacity for some form of solar-derived energy. The windpower-deficient Southeast and Southwest (in addition to the windy South Central region) have excellent solar potential. Biofuel prospects for the Southeast are favorable. The highest windpower-potential regions in the United States are the darkest corner of the Pacific North-

west, the cloudy eastern Great Lakes region, and the much sunnier coasts of southern New England. The less windy and not-so-sunny stretches of northern New England have forests that could, with good ecosystem management, provide indefinitely renewable biofuel energy for that region. The many hundreds of abandoned mill dams in New England could be outfitted to generate a total of many megawatts of hydropower. The Grand Coulee Dam, now rated at 6,000 megawatts and expandable to 10,000 megawatts within the capabilities of the watershed, could keep Washington state in the ranks of energy exporters.

Hydropower scale is limited by the flow and head available at a site. Because the cost of additional turbine-generators is small once the dam is there, the economics of rising energy costs will cause hydropower sites to be developed to their maximum potential. The scale and locations of good hydropower sites will play a large role in determining village scale and economic activity. The economics that caused mill towns to be built may well return with the depletion of nonrenewable energy resources.

Forest biofuel production per square mile is ultimately limited by the forest's capacity to replace biomass. The energy costs of wood shipment keep the practical radii from forest to generating plant down to a few tens of miles. An area with a 20 mile radius cannot renewably support a net electric power yield greater than approximately 100 megawatts. The income from that scale of operation would support no more than 1,000-2,000 workers engaged in plant upkeep, harvesting, forest management, business, and accounting, etc. Adding worker families and service industry workers and families gives a rough order of magnitude of the size of the community that might derive support from forest energy export: 10,000-20,000 at most. Space heating for the community ideally would come from waste heat. If some export took the form of manufactured goods that used the energy from the power plant and perhaps some of its heat (in a co-generation process), then the potential size of the community supported by forest energy would increase considerably. These figures indicate upper limits, not optimum size. They suggest a significant potential dispersion of population supported by biomass forest income.

In level windy regions, windpower potential can be fairly good at sufficient tower altitude, regardless of location. But the most economically attractive windpower sites will be determined by topographic features: ridges, coastlines, mountain gaps, and accessible mountain tops. These sites will generally not support large arrays of wind turbines, but more frequently a single row of turbines lim-

ited to the length of the ridge or the width of the wind gap. It turns out that the maximum power potential for such sites depends on the characteristic length or width of the topographic feature and on the vertical distance swept by rotors over that horizontal span. The implication is that large wind turbines extract more power at prime sites than small turbines when site saturation is achieved. There will be therefore pressure to install the largest practical wind turbines. The most economical scale for wind turbines is subject to debate, but it seems that a rated capacity of 1-3 megawatts is an upper bound beyond which complexity and sheer weight outweigh any further advantages of increased scale. Lest this scale cause some readers to flinch, it is worth recalling that the first megawatt-scale machine to operate (excepting the 1945 Smith-Putnam turbine on Grandpa's Knob, Vermont) was the 2 megawatt turbine that was designed, constructed, and financed almost entirely by students and faculty members of the Danish Technical High School/Junior College at Tvind in the mid seventies.

The examples so far have dealt with maximum scale for solar technologies and have assumed significant economic activity oriented around the energy supply. A more usual energy system for a village would serve the ordinary demands of residences, commercial establishments, and perhaps light industry, but not energy-intensive industries such as metal forging or glass production (from recycled materials or otherwise). The largest quantitative energy demands would be low-temperature thermal end-uses: space and hot water heating, refrigeration and freezing, and possibly air conditioning. Where solar potential was good, heat demands would best be met on a house-by-house basis using passive solar architecture, and trees should be the first defense against heat. If nights are cool, as at high altitudes and in the desert, passive storage of night coolness should be a function of housing design. But two factors may favor neighborhood (or larger) scale thermal systems. The first is existing housing that is difficult to retrofit. The other is regions of poor solar potential or air cooling needs. In these situations, large-scale insulated water tanks could store summer heat and winter cold on a seasonal basis. Hot water could be stored using year-round active solar collection or wind-driven heat pumps. Cold water could be stored using wintertime convective heat exchange to ambient or wind-driven mechanical refrigeration, perhaps with the same device whose other end is generating stored hot water. The advantage of the relatively large scale for seasonal thermal storage is declining cost per unit capacity and an improved surface-to-volume ratio that makes tank

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